



Australian Government

Department of Infrastructure and Transport



**Transport
Canada**

Joint Australian and Canadian Pole Side Impact Research

Thomas Belcher

Australian Government Department of Infrastructure and Transport

Suzanne Tylko

Transport Canada

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Program Overview



- Paired comparisons of 29 km/h perpendicular and 32 km/h oblique pole side impact tests with WorldSID 50th percentile adult male ATDs.
- Canadian market vehicles including Chevrolet Cruze, Suzuki Kizashi, Mitsubishi RVR (ASX), Mazda 2, Ford Fiesta, Dodge Journey and Nissan Juke.

All have separate head curtain and seat mounted thorax side airbags.

- Australian market vehicle, Ford Falcon* added to plots for comparison.

Seat mounted head/thorax combination side airbag.

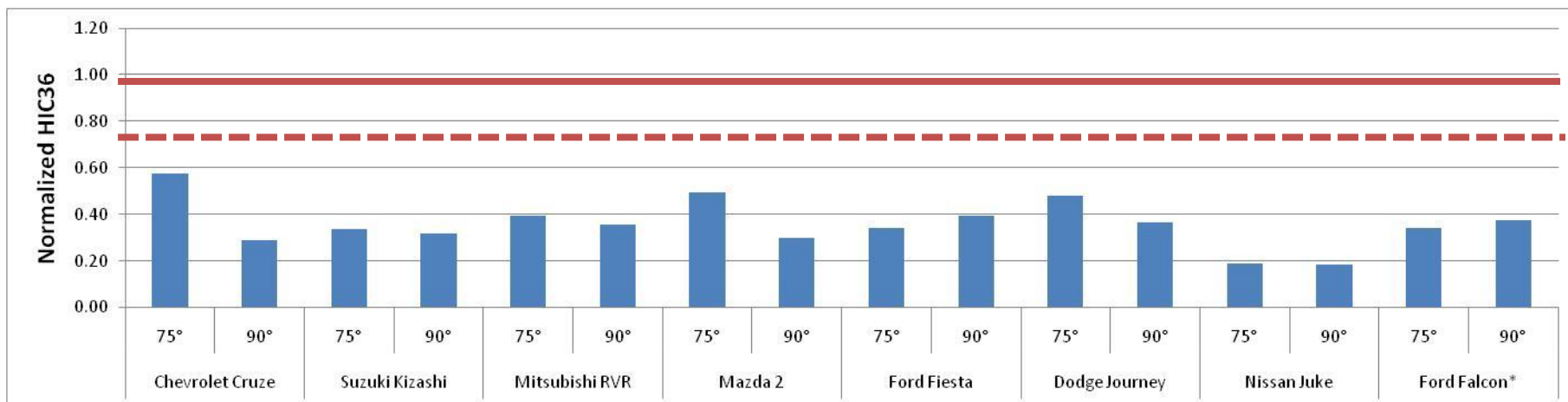
*NB: Perpendicular test was conducted at 32 km/h for this vehicle model.



Head Injury Risk



HIC36 (excluding dummy occupant-to-occupant head interactions / calculated for $t < 80\text{ms}$)



50% AIS 3+ Head Injury Risk

30% AIS 3+ Head Injury Risk

- HIC36 results suggest probability of AIS 3+ head injury from head to airbag/pole interaction is less than 20% in all vehicles.
- For majority of vehicle models 32 km/h oblique pole tests produced HIC36 results greater than or equal to 29 km/h perpendicular pole tests.
- Technically feasible to achieve/ensure less than 30% AIS 3+ head injury risk.
- Occupant-to-occupant head collisions ($\text{HIC36} > 2000$) occurred in every test.

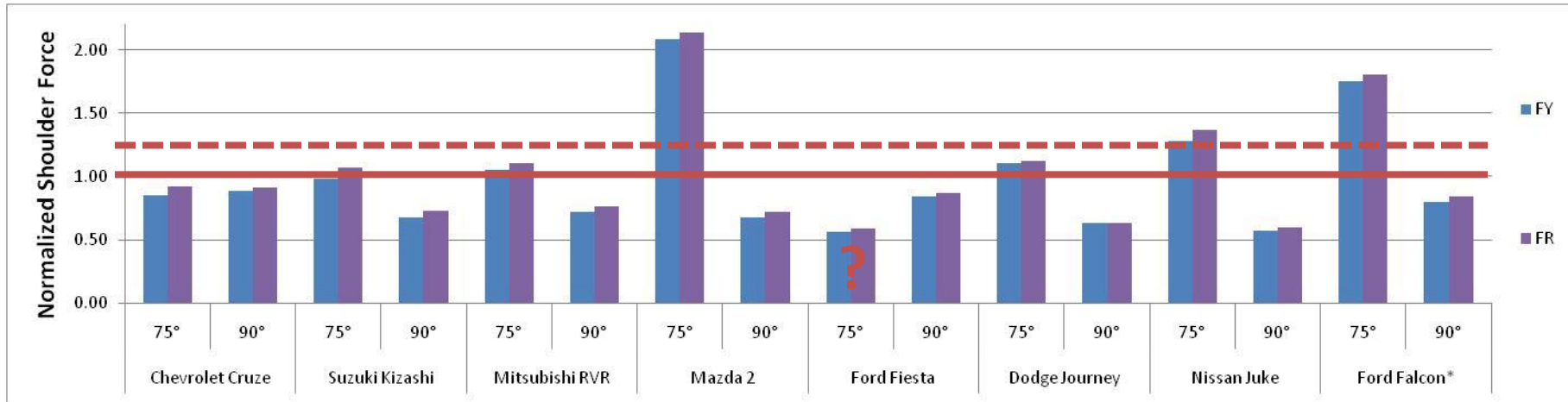
Head injury risk has been determined using the Prasad/Mertz AIS 3+ skull fracture probability risk function published in FMVSS 214 Final Regulatory Impact Analysis (August 2007).



Shoulder Injury Risk



Maximum Shoulder Force



50% AIS 2+ Shoulder Injury Risk (relative to F_Y)

95% AIS 2+ Shoulder Injury Risk (estimate)

- For all vehicle models except Ford Fiesta (NB(?): shoulder rib broke in oblique test of Ford Fiesta), 32 km/h oblique pole impact produced shoulder forces greater than or at least equal to 29 km/h perpendicular pole impact.
- Peak lateral (F_Y) shoulder force was very similar to peak resultant (F_R) shoulder force in every test.
- May be feasibility issues associated with applying a 50% AIS 2+ shoulder force limit – most current model vehicles would probably fail such a limit if applied to a 32 km/h oblique pole test. Benefit?
- Shoulder RibEye drop outs consistently occur for theoretical IRTRACC deflections around 60 mm – theoretical shoulder rib IRTRACC deflection was unable to be calculated from most vehicle-to-pole tests.

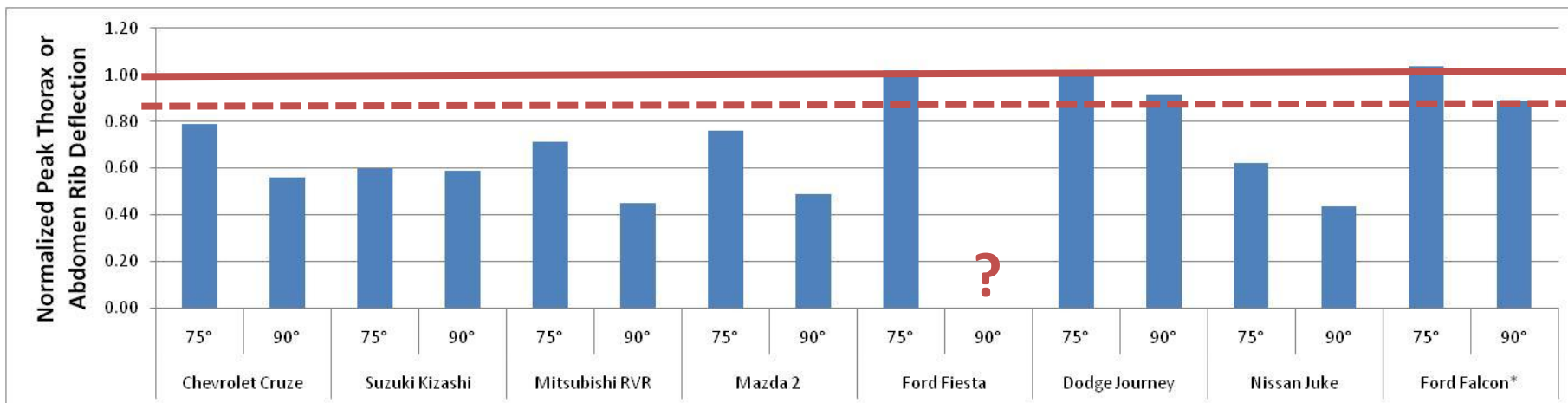
Shoulder injury risk has been determined from the AIS 2+ (survival method) shoulder injury risk curve published by Petitjean et al., Stapp 2009.



Thorax Injury Risk



Maximum Thorax or Abdomen Rib Theoretical IRTRACC Deflection



50% AIS 3+ Thorax Injury Risk

30% AIS 3+ Thorax Injury Risk

- For all vehicle models, 32 km/h oblique pole tests produced maximum thorax or abdomen rib deflections greater than or at least equal to 29 km/h perpendicular pole tests.
- Three vehicles exceeded (marginally) 50% AIS 3+ thorax injury risk in oblique pole test.
- Five vehicles had less than 30% AIS 3+ thorax injury risk in oblique and perpendicular pole tests.
- Ford Fiesta theoretical IRTRACC deflections unable to be determined (?) in perpendicular pole test due to dropouts caused by large forward movement of RibEye LEDs relative to sensor.

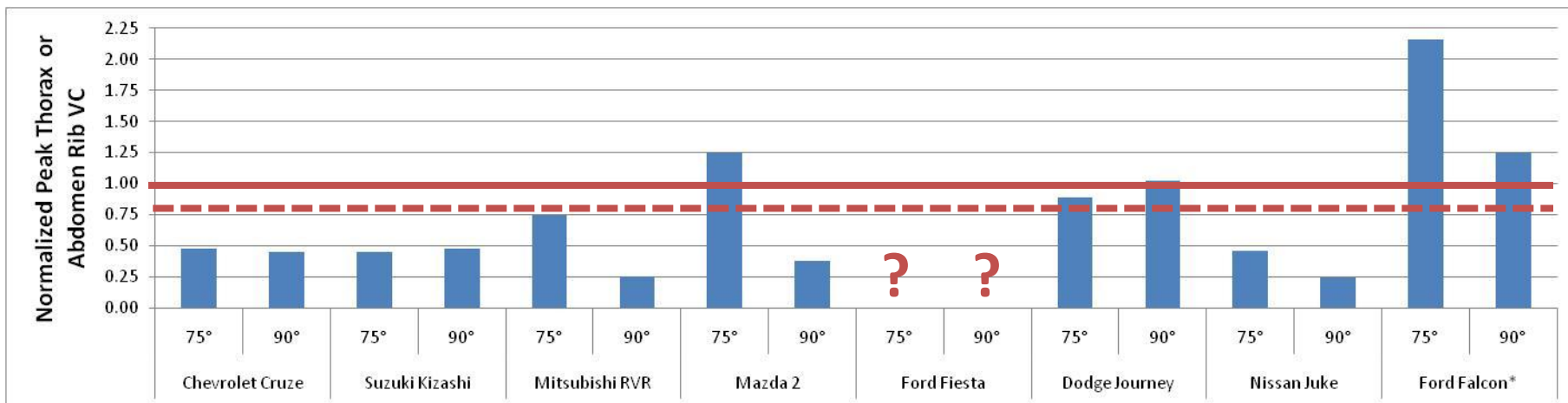
Thorax injury risk has been determined from the AIS 3+ (survival method) thorax injury risk values (adjusted to 45 year old) published by Petitjean et al., Stapp 2009.



Thorax Injury Risk



Maximum Thorax or Abdomen Rib Viscous Criterion (VC)



50% AIS 3+ Thorax Injury Risk

30% AIS 3+ Thorax Injury Risk

- 32 km/h oblique pole tests produced maximum thorax or abdomen rib viscous criterion responses either greater than or at least similar to 29 km/h perpendicular pole tests.
- Two vehicles exceeded 50% AIS 3+ thorax injury risk in oblique pole test.
- Four vehicles had less than 30% AIS 3+ thorax injury risk in oblique and perpendicular pole tests.
- Ford Fiesta viscous criterion response values (?) unable to be reliably determined due to RibEye dropouts.

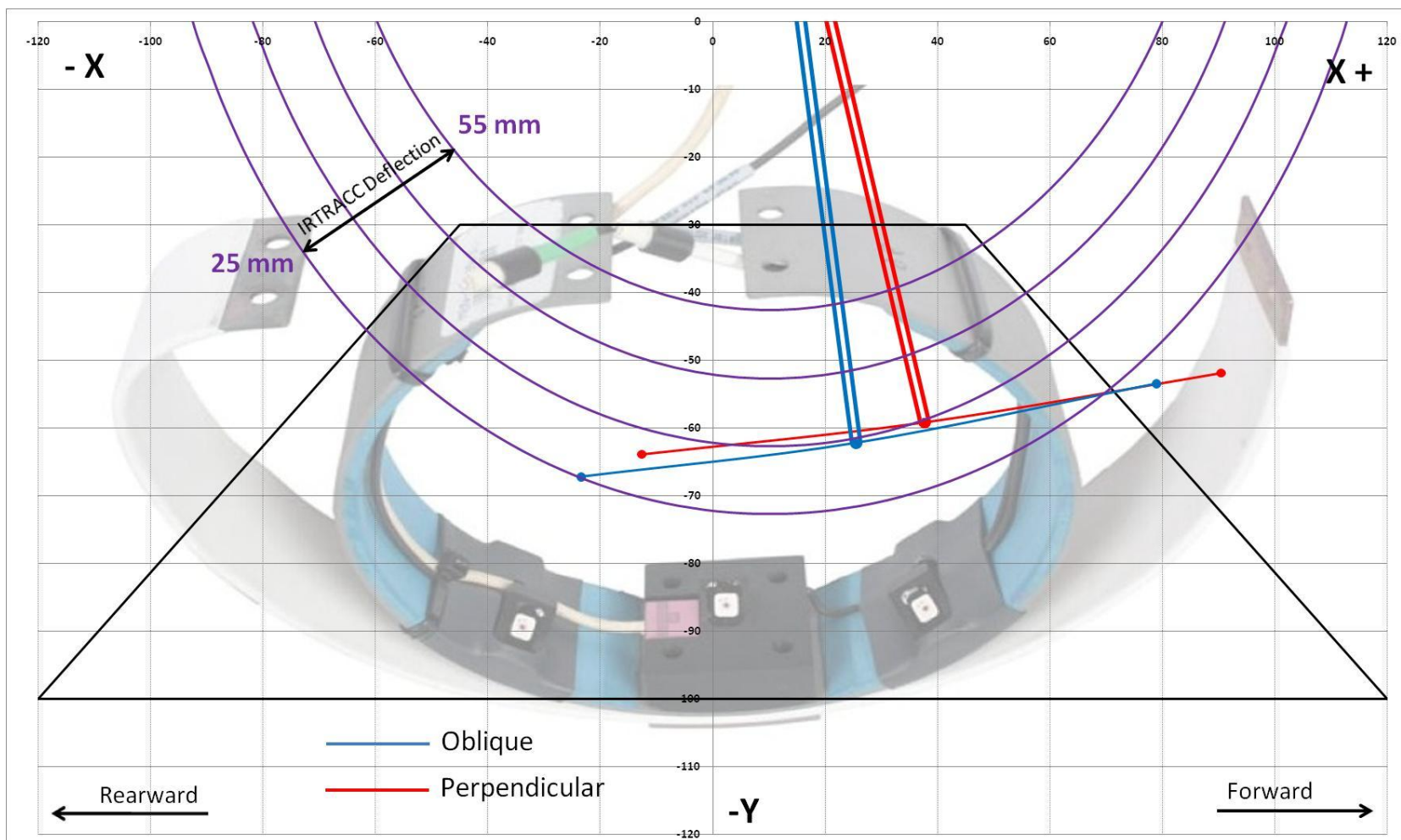
Thorax injury risk has been determined from the AIS 3+ (survival method) thorax injury risk values (adjusted to 45 year old) published by Petitjean et al., Stapp 2009.



Suzuki Kizashi



X-Y Response (0-100ms): Thorax Rib 2

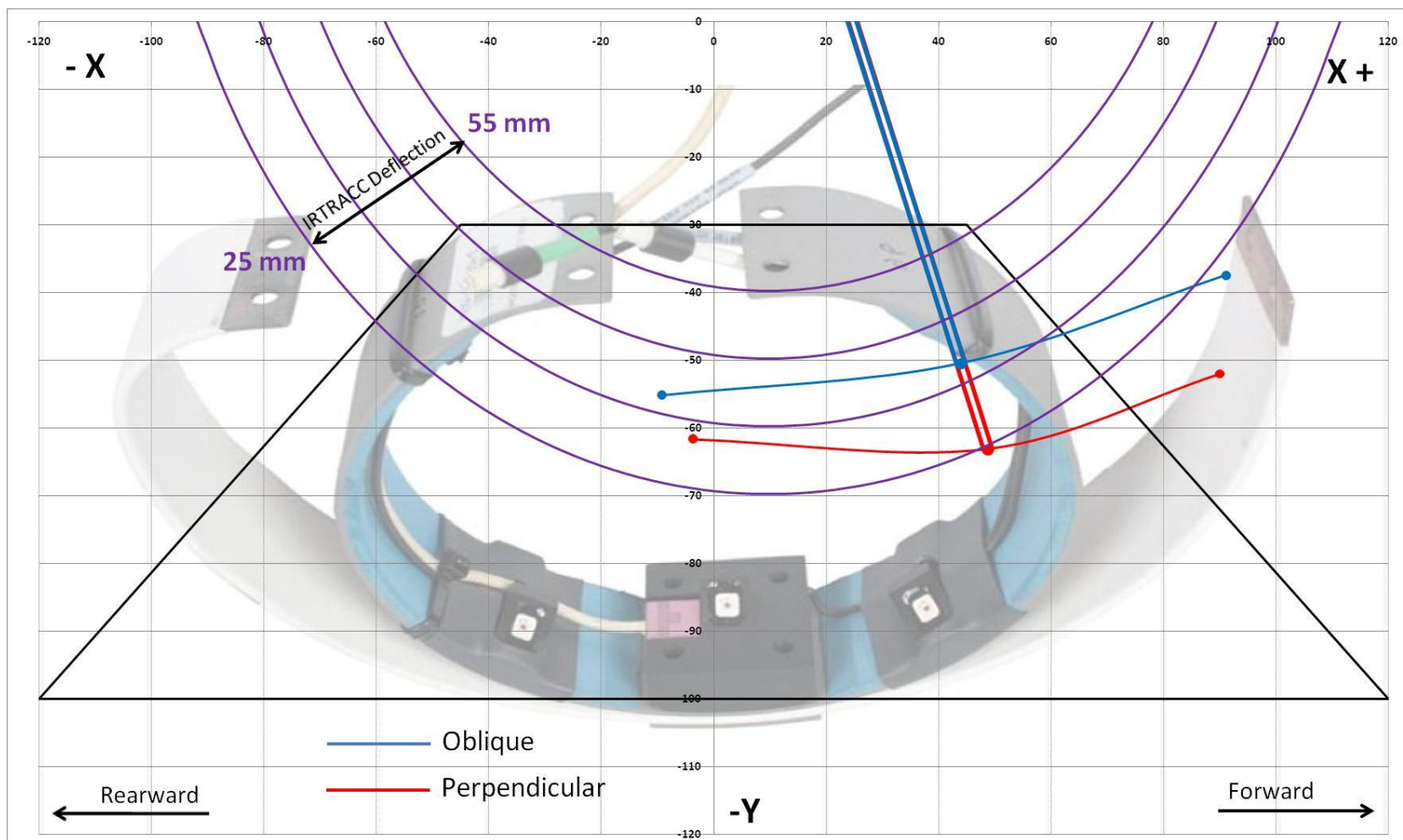




Mitsubishi RVR



X-Y Response (0-100ms): Thorax Rib 1

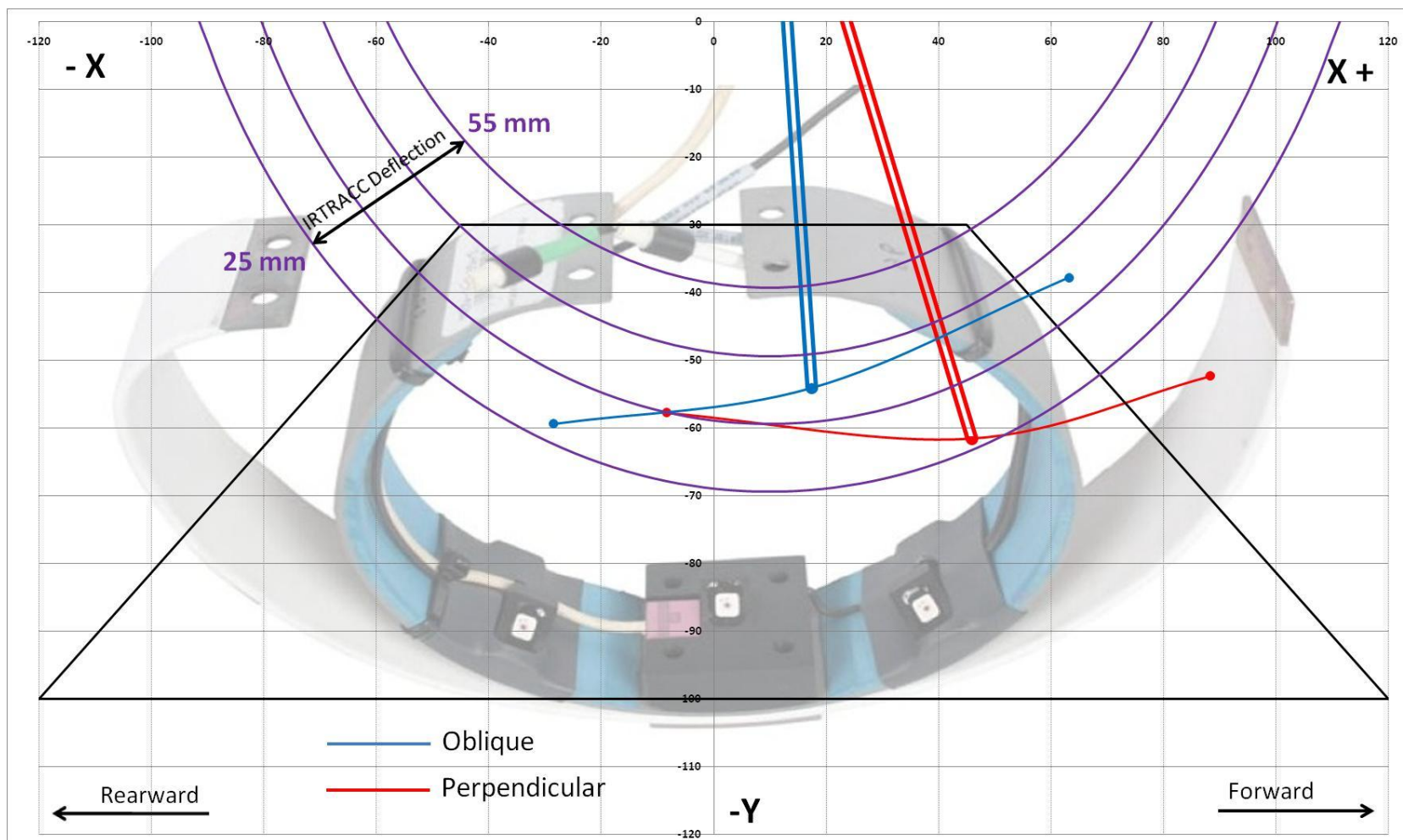




Mazda 2



X-Y Response (0-100ms): Thorax Rib 1

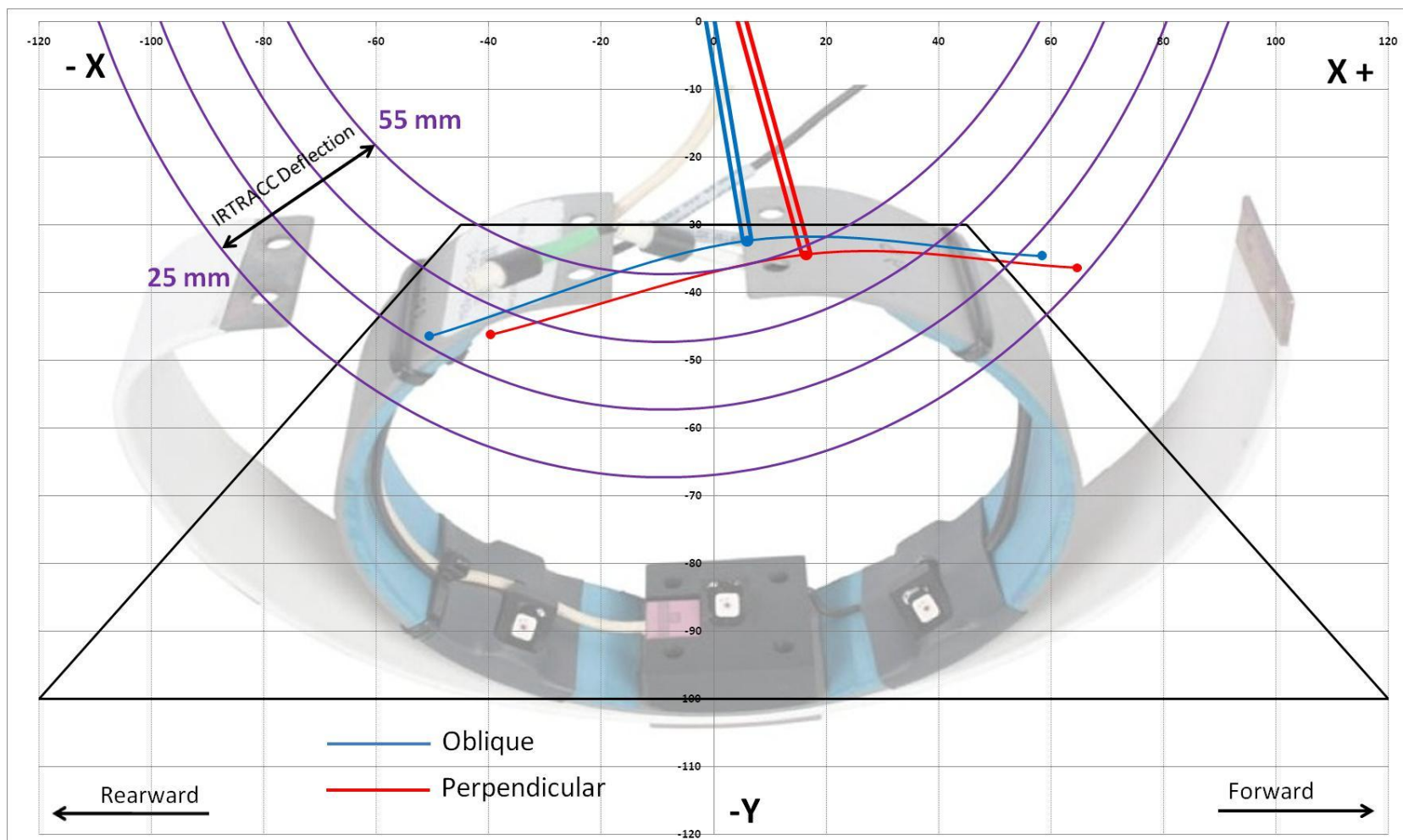




Dodge Journey



X-Y Response (0-100ms): Thorax Rib 3

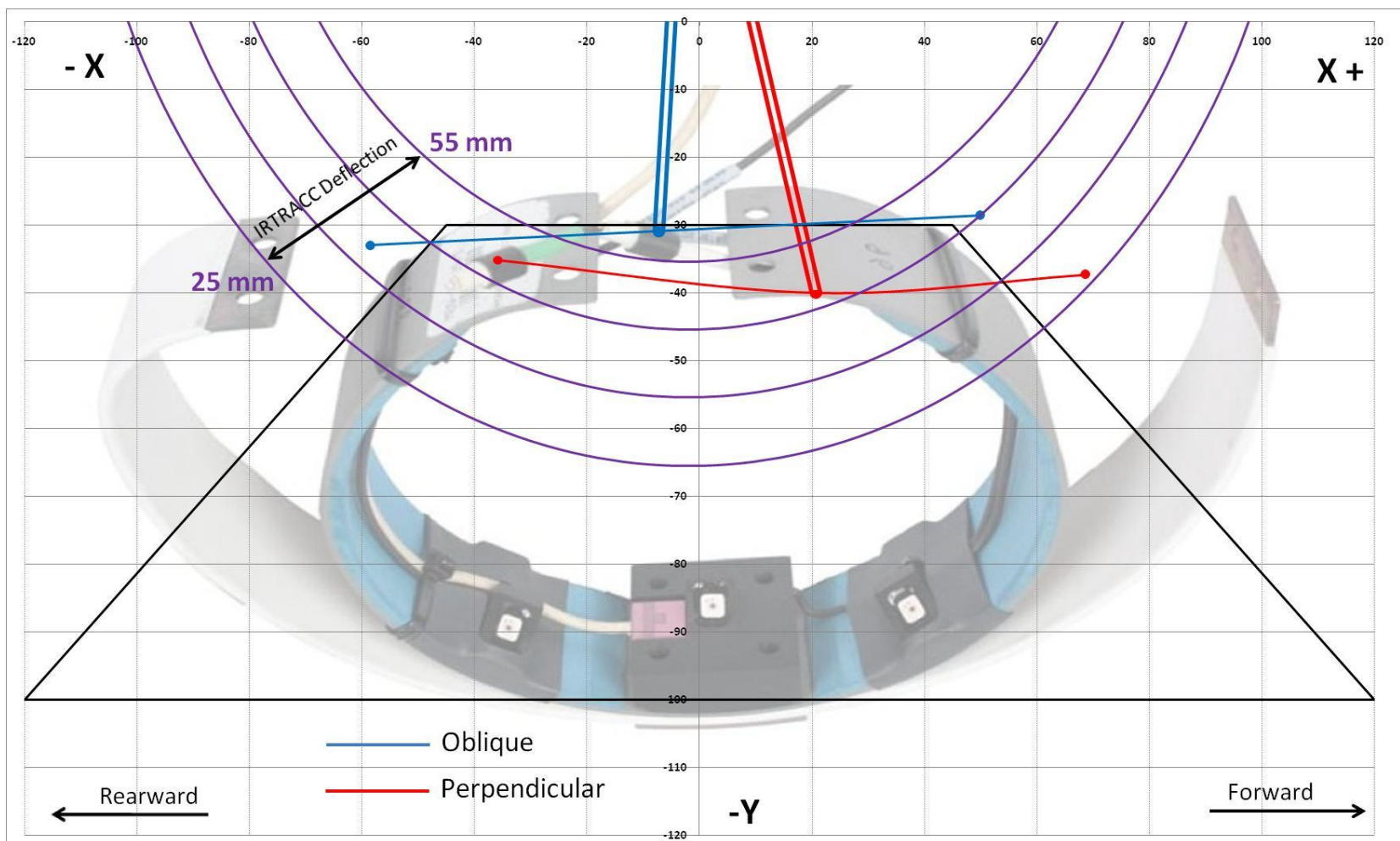




Ford Falcon



X-Y Response (0-100ms): Abdominal Rib 1

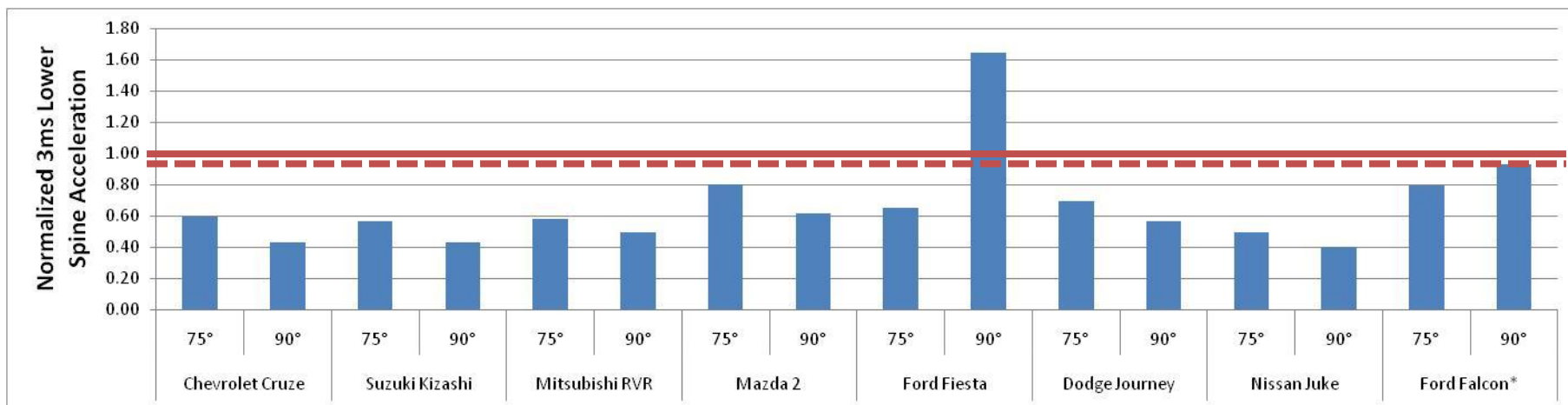




Abdomen Injury Risk



3ms Lower Spine Acceleration



50% AIS 3+ Abdominal Injury Risk

25% AIS 3+ Abdominal Injury Risk

- 3ms lower spine acceleration responses suggest less than 25% AIS 3+ abdominal injury risk in all but one test.
- For a majority of vehicle models, 32 km/h oblique pole tests produce higher 3ms T12 acceleration than 29 km/h perpendicular pole tests.

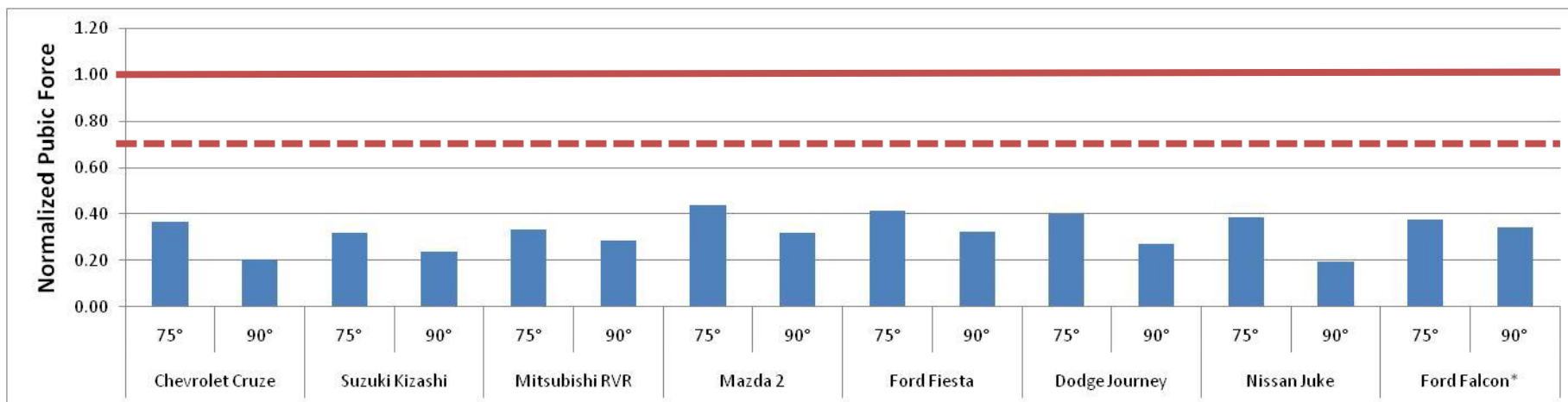
Abdomen injury risk has been determined from the AIS 3+ (survival method) abdomen injury risk values (adjusted to 45 year old) published by Petitjean et al., Stapp 2009.



Pelvis Injury Risk



Peak Pubic Symphysis Force



50% AIS 3+ Pelvis Injury Risk

5% AIS 3+ Pelvis Injury Risk

- 32 km/h oblique pole tests produced higher pubic symphysis forces than 29 km/h perpendicular pole tests.
- Pubic symphysis force responses suggest much less than 5% probability of AIS 3+ pelvis injury for each vehicle model/test.

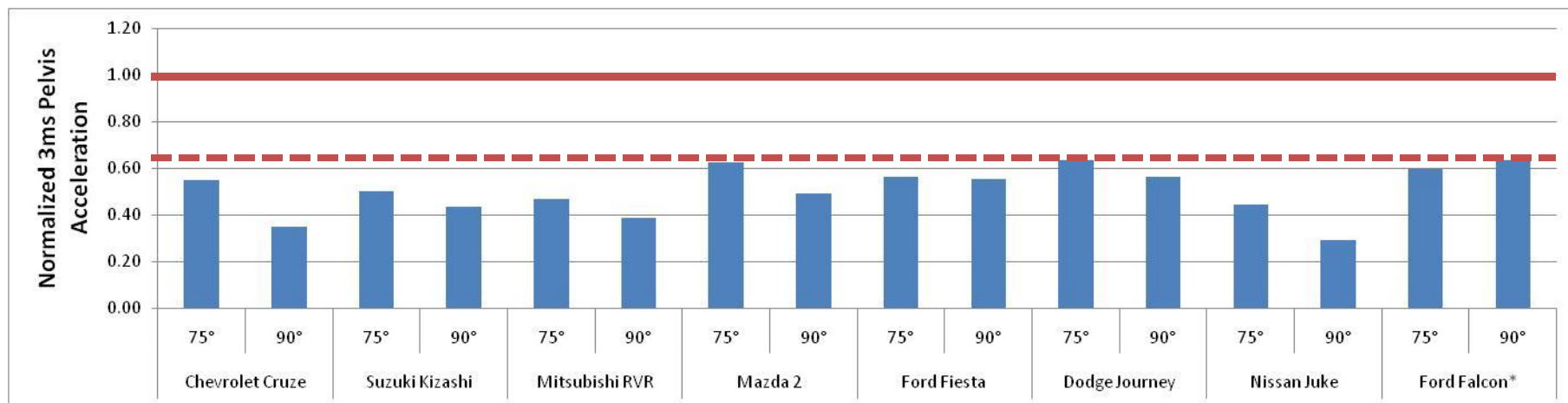
Pelvis injury risk has been determined from the AIS 3+ (survival method) pelvis injury risk values (adjusted to 45 year old) published by Petitjean et al., Stapp 2009.



Pelvis Injury Risk



3ms Pelvis Acceleration



50% AIS 3+ Pelvis Injury Risk

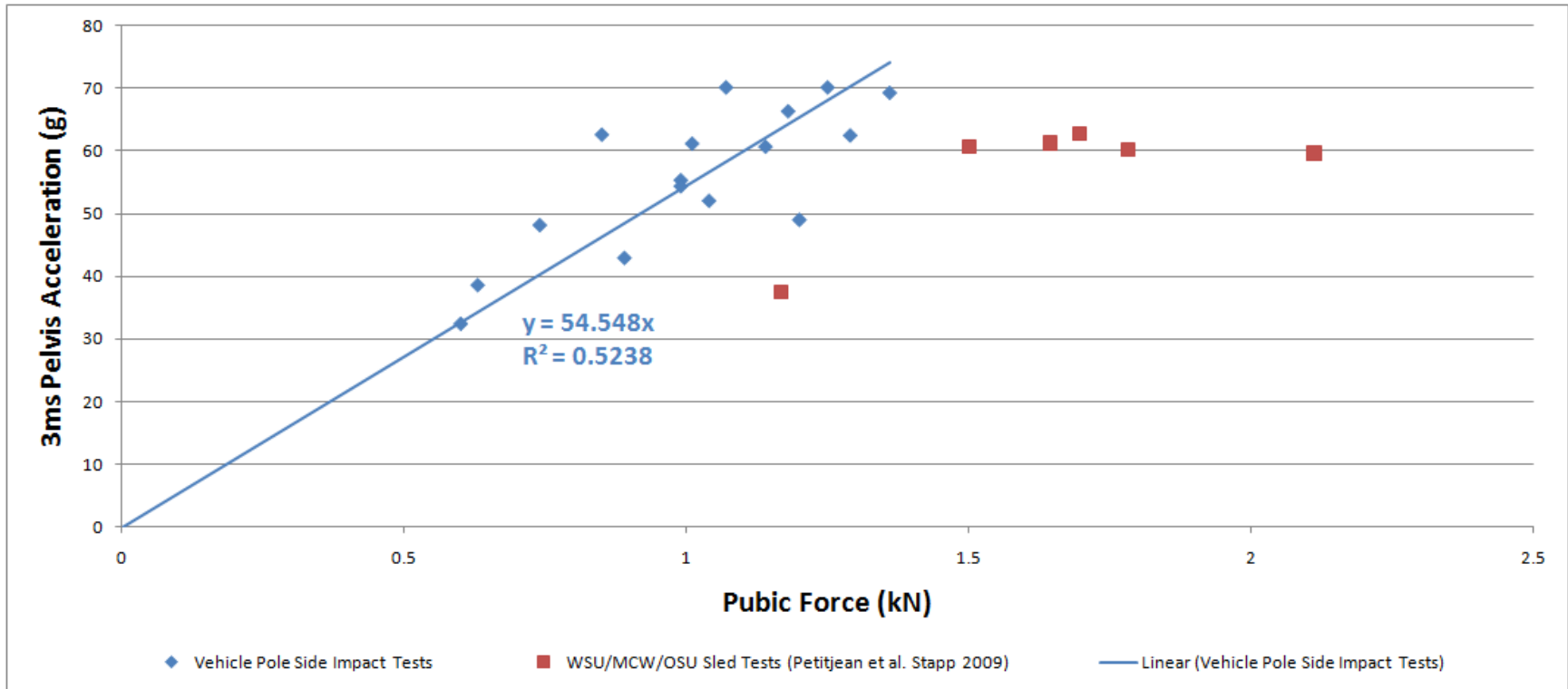
5% AIS 3+ Pelvis Injury Risk

- 32 km/h oblique pole tests consistently produced higher 3ms pelvis acceleration than 29 km/h perpendicular pole tests.
- 3ms pelvis acceleration results suggest less than 5% probability of AIS 3+ pelvis injury for each vehicle model/test.
- 3ms pelvis acceleration results consistently indicate higher probability of AIS 3+ pelvis injury than the peak pubic symphysis force recorded during the same test.

Pelvis injury risk has been determined from the AIS 3+ (survival method) pelvis injury risk values (adjusted to 45 year old) published by Petitjean et al., Stapp 2009.



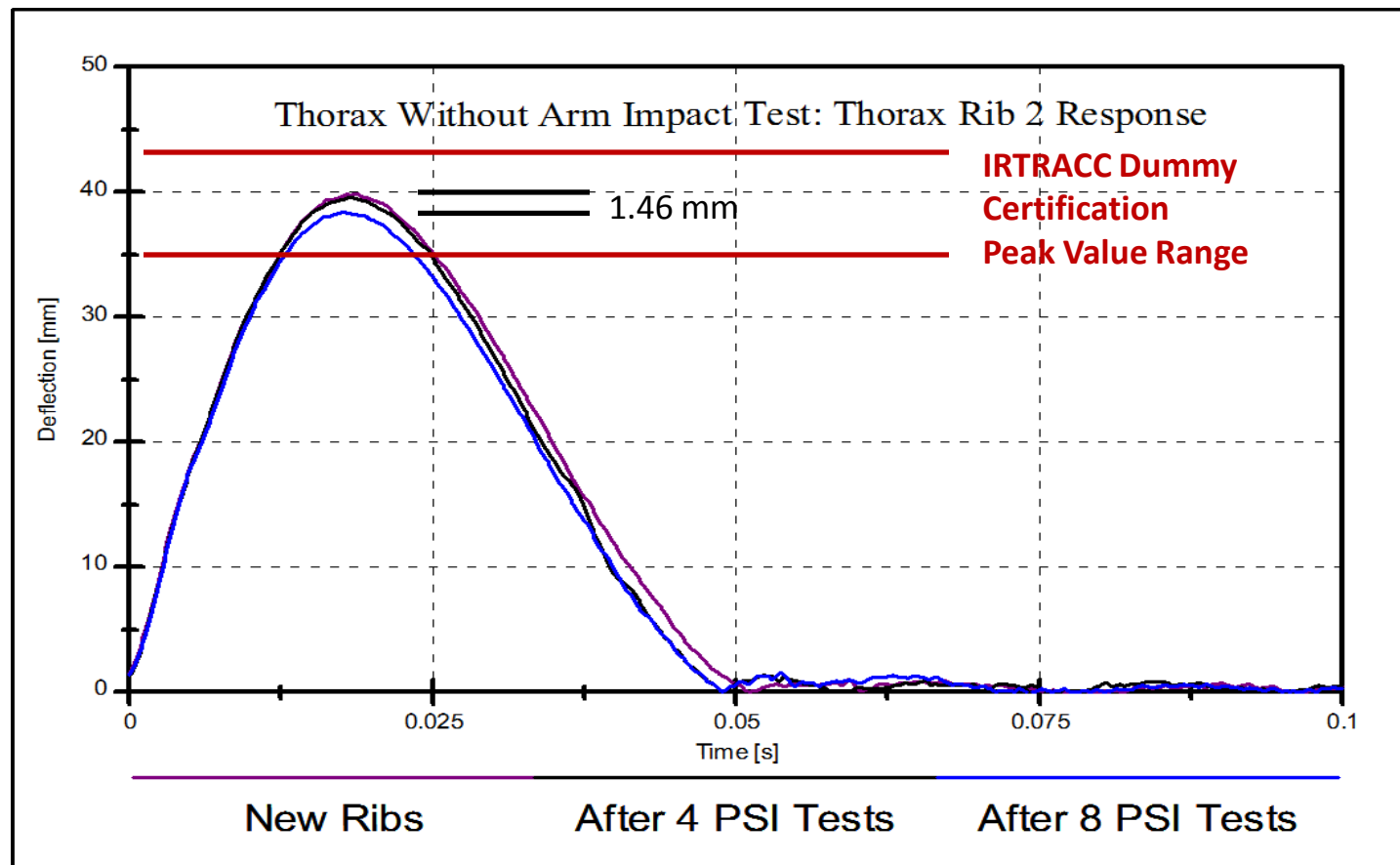
Correlation of WorldSID 50M Pelvis Responses



- 3ms pelvis accelerations occur across similar range for vehicle-to-pole side impact tests and sled tests used to establish pelvis injury risk function.
- Peak pubic symphysis forces are in lower range for vehicle-to-pole side impact tests than sled tests used to establish pelvis injury risk function.



WorldSID 50M RibEye Calibration Responses



Theoretical IRTRACC responses obtained from WorldSID 50th percentile adult male dummy with RibEye towards the middle of the ISO 15830 certification corridor for WorldSID with IRTRACC.



Summary



- Likely that many current model vehicles would fail shoulder force/deflection thresholds based on 50% AIS 2+ shoulder injury risk.
- Consistently more forward movement of ribs in perpendicular pole tests than oblique pole tests.
- Current injury risk curves were developed for lateral rib deflection (i.e. are not suited to rib deflection responses with large forward movement and may underestimate injury risk in such cases).
- WorldSID 50th male typically predicted lower injury risks for abdomen and pelvis when compared to head or thorax.
- Highest AIS 3+ injury risks typically occurred for WorldSID 50th male thorax.
- Majority of WorldSID 50th male injury responses were higher for 32 km/h oblique pole tests than 29 km/h perpendicular pole tests.

Thank you